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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART VI COMPOSITE TEMPERATURE/HUMIDITY CYCLIC TEST

(Second Reprint JULY 1994)

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BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART VI COMPOSITE TEMPERATURE/HUMIDITY CYCLIC TEST

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BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART VI COMPOSITE TEMPERATURE/HUMIDITY CYCLIC TEST

0. FOREWORD

0.1 This Indian Standard (Part VI) was adopted by the Indian Standards Institution on 28 April 1978, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 A composite temperature/humidity cyclic test (moisture resistance test) is designed to reveal defects in test items caused by breathing as distinct from the absorption of moisture. This test differs from other cyclic damp heat tests in that it derives its increased severity from:

a) the greater number of temperature variations or pumping actions in a given time;

b) the greater cyclic temperature range;

c) the higher cyclic rate of change of temperature;

d) the inclusion of a number of excursions to sub-zero temperatures; and

e) the inclusion of vibration conditioning, if required.

0.2.1 The accelerated breathing and the effect of the freezing of trapped water in cracks and fissures are the essential features of this composite test. It is emphasized, however, that the freezing effect will occur only *if* the fissure dimensions are large enough to allow the penetration of a coherent mass of water, as is normally the case in fissures between seals and metal assemblies or between seals and wire terminations.

0.2.2 The degree of condensation will depend mainly upon the thermal time constant of the surface of the test items and may be negligible for very small items but copious for large items.

0.2.3 The breathing effect will be more apparent on items which contain relatively large air-filled or gas-filled voids but again the severity of the test will depend to some extent on the thermal characteristics of the items.

0.3 It is recommended that this test procedures should be limited to component type of items when the construction of the items suggests a breathing type of damp heat test combined with icing and where the thermal characteristics are compatible with rates of change of temperature.

0.3.1 As in other damp heat tests, a polarizing voltage or electrical loading may be applied to the items. In the case of electrical loading, the loading should be such that the temperature rise of the items does not unduly affect the chamber conditions.

0.3.2 It is to be noted that composite temperature/humidity cyclic test should not be considered to be interchangeable with, or an alternative to, either steady state or other cyclic damp heat tests, but the choice of test procedure should be made with due regard for the physical and thermal characteristics of the test items and the types of failure mechanisms which are significant for each particular case.

0.4 This standard has been largely based on IEC Publication 68-2-38 (1974) ' Basic environmental testing procedures, Part 2 : Tests, Test Z/AD composite temperature/humidity cyclic test ' issued by the International Electrotechnical Commission.

0.5 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part VI) deals with a composite temperature/humidity cyclic (moisture resistance) test procedure designed to reveal defects in test items caused by breathing as distinct from the absorption of moisture.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977† shall apply.

3. OBJECT

3.1 The object of this standard is to provide a composite test procedure, primarily intended for component type item, to determine in an accelerated manner the resistance of items to the deteriorative effects of high temperature/humidity and cold conditions and vibration conditioning when required.

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*Rules for rounding off numerical values (*revised*).

†Basic environmental testing procedures for electronic and electrical items : Part I General.

4. GENERAL DESCRIPTION OF THE TEST

4.1 The test employs temperature cycling at high-relative humidity and is designed to produce a breathing action of moisture into partially sealed containers. The test includes exposure to low temperatures to determine the effects of periodic icing.

5. DESCRIPTION OF TEST APPARATUS

5.0 The exposure to temperature/humidity cycle, followed by an exposure to cold, may either be performed in two separate chambers (*see* **5.1**) or in a single composite chamber (*see* **5.2**). If vibration conditioning is included as a part of the cold cycle, a suitable vibration test equipment shall be used.

5.1 Exposure in Two Separate Chambers

5.1.1 The chamber for the exposure to temperature/humidity cycle shall conform to the relevant provisions of IS : 9002 (Part III)* except as modified below:

a) The temperature can be varied between 25 ± 2°C and 65 ± 2°C in a period of between 1·5 h and 2·5 h for both rising and falling temperatures.

b) The relative humidity can be maintained at 93 ± 3 percent during the periods of constant or rising temperature and between 80 and 96 percent relative humidity during the falling temperature periods.

5.1.2 The chamber for the exposure to cold cycle shall conform to the relevant provisions of IS : 9002 (Part I)-1977† except as modified below:

a) The temperature can be maintained at — 10 ± 2°C.

b) Care shall be taken to ensure that the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature sensing devices.

5.1.3 The equipment for vibration test shall conform to the relevant provisions of IS : 9002 (Part V)‡.

NOTE — Until the standard under preparation is published the matter shall be subject to agreement between the concerned parties.

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*Specification for equipment for environmental tests for electronic and electrica items : Part III Humidity chamber (*under preparation*).

†Specification for equipment for environmental tests for electronic and electrical items : Part I Chamber for cold test.

‡Specification for equipment for environmental tests for electronic and electrieal items : Part V Equipment for vibration test (*under preparation*).

5.2 Exposure in a Single Composite Chamber — The composite chamber for temperature humidity cycle test shall meet the relevant provisions of IS : 9002 (Part III)* for humidity chamber requirements and IS : 9002 (Part I)-1977† for cold chamber requirements except as modified below :

a) The temperature can be varied between 25 ± 2°C and 65 ± 2°C in a period of between 1·5 h and 2·5 h for both rising and falling temperature.

b) The relative humidity can be maintained at 93 ± 3 percent during the periods of constant or rising temperature and between 80 and 96 percent relative humidity during the falling temperature periods.

c) Care shall be taken to ensure that the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature and humidity sensing devices. The air in the chamber shall therefore be continuously stirred at a rate necessary to maintain the specified conditions of temperatue and humidity.

d) The items under test shall not be subjected to radiant heat from the chamber conditioning processes.

e) Water used for the maintenance of chamber humidity shall have a resistivity of not less than 500 Ωm. Condensed water is continuously drained from the chamber and not used again until it has been repurified. Precautions shall be taken to ensure that no condensed water from the walls and roof of the test chamber can fall on the items.

f) The temperature can be lowered from 25 ± 2°C to — 10 ± 2°C in a period of not more than 30 min.

g) The item can be held at a temperature of — 10 ± 2°C for a period of 3 h.

h) The temperature can be raised from — 10 ± 2°C to 25 ± 2°C in a period of not more than 90 min.

5.2.1 The equipment for vibration test shall conform to IS : 9002 (Part V)‡.

---

*Specification for equipment for environmental tests for electronic and electrical items: Part III Humidity chamber (*under preparation*).

†Specification for equipment for environmental tests for electronic and electrical items: Part I Chamber for cold test.

‡Specification for equipment for environmental tests for electronic and electrical items: Part V Equipment for vibration test (*under preparation*).

6. SEVERITIES

6.1 The number of 24 h cycles shall be 10, unless otherwise specified. The relevant specification shall specify the following:

a) Number of cycles if other than 10;

b) Number and position of the cold cycles in the sequence; and

c) Vibration conditioning as a part of cold cycle, if required.

7. TEST PROCEDURE

7.1 Pre-conditioning (*see* **Fig. 1**) — Unless otherwise specified, the items in the unpacked, switched off, ready-for-use-state shall be maintained at a temperature of 55° ± 2°C with a relative humidity not exceeding 20 percent for a period of 24 h. The items shall then be allowed to attain thermal stability at standard atmospheric conditions for testing or as otherwise specified before the initial measurements are made.

7.2 Initial Measurements — The items shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

7.3 Conditioning — The items shall be introduced into the temperature/humidity chamber, in the unpacked, switched off, ready-for-use-state, and mounted in the normal orientation, if this is known, or as otherwise specified and shall be subjected to 10 temperature/humidity cycles, each of 24 h duration (*see* **7.3.1.1**). During any five of the first nine of the above cycles after exposure to the temperature/humidity sub-cycle (*a-f* in Fig. 2A) the items shall be subjected to cold (*see* **7.3.1.2**). This exposure may be performed either in the same chamber or in separate chambers. If separate chambers are used for the high-temperature/high-humidity and low-temperature sub-cycles of the test, the items should not be subjected to thermal shock conditions unless it is known that they are insensitive to this degree of thermal shock. The remaining four of the first nine cycles shall be run without exposure to cold (*see* **7.3.1.4** and Fig. 2B). The temperature/humidity cycles prescribed are the same in all cases. If required by the relevant specification, the items shall be subjected to vibration test as specified in IS : 9002 (Part V)* followed cold sub-cycle.

7.3.1 *Description of 24 h Cycle*

7.3.1.1 *Description of temperature/humidity sub-cycle* (*applicable to all cycles, see* Fig. 2A and 2B):

a) At zero time of every 24 h cycle, the chamber condition shall be controlled to a temperature of 25 ± 2°C and relative humidity of 93 ± 3 percent.

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*Specification for equipment for environmental tests for electronic and electrical items: Part V Equipment for vibration test (*under preparation*).

b) The temperature of the chamber shall be continuously raised to 65 ± 2°C in a period of between 1·5 and 2·5 h.

During this period, the relative humidity shall remain within the limits 93 ± 3 percent.

c) The temperature and relative humidity in the chamber shall be maintained at 65 ± 2°C and 93 ± 3 percent respectively until 5·5 h after the start of the cycle.

d) The temperature shall then be allowed to fall to 25 ± 2°C in a period of between 1·5 h and 2·5 h.

During this period, the relative humidity shall remain within the limits 80 to 96 percent.

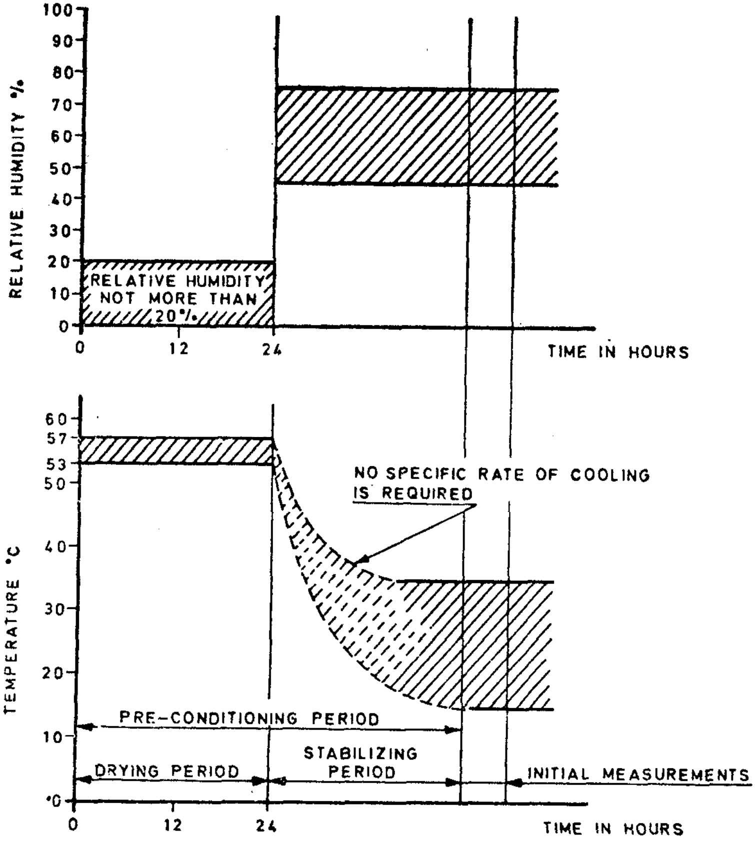
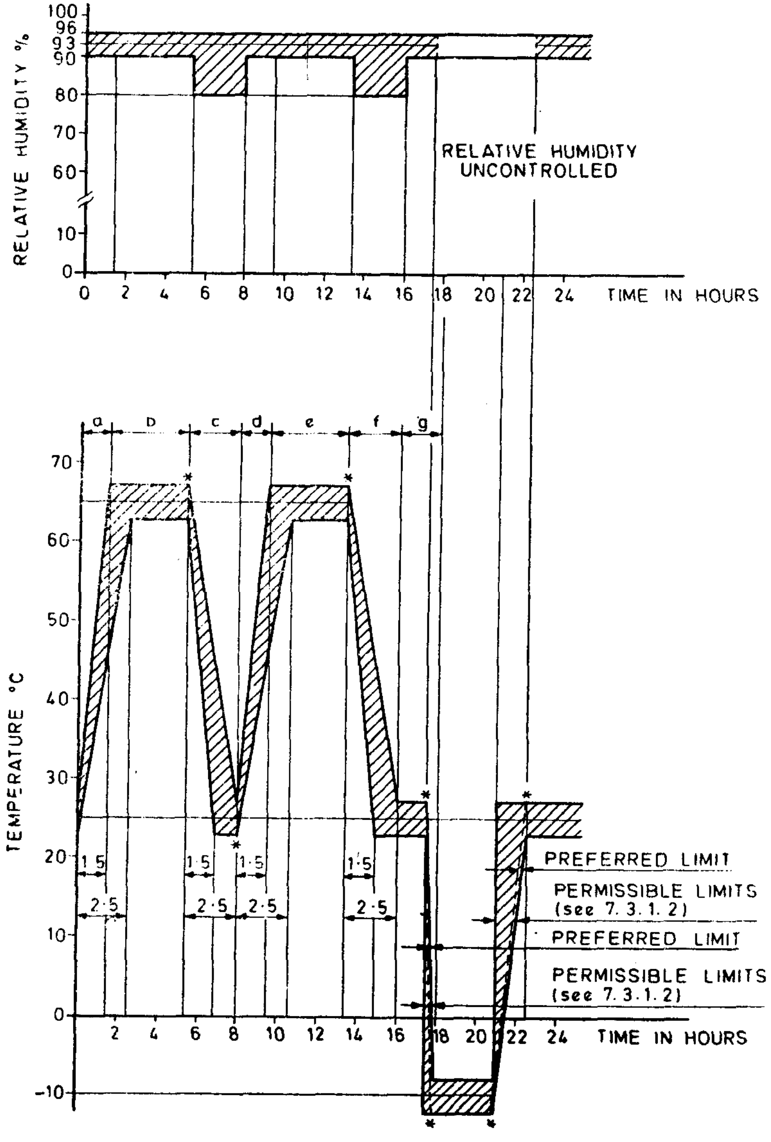


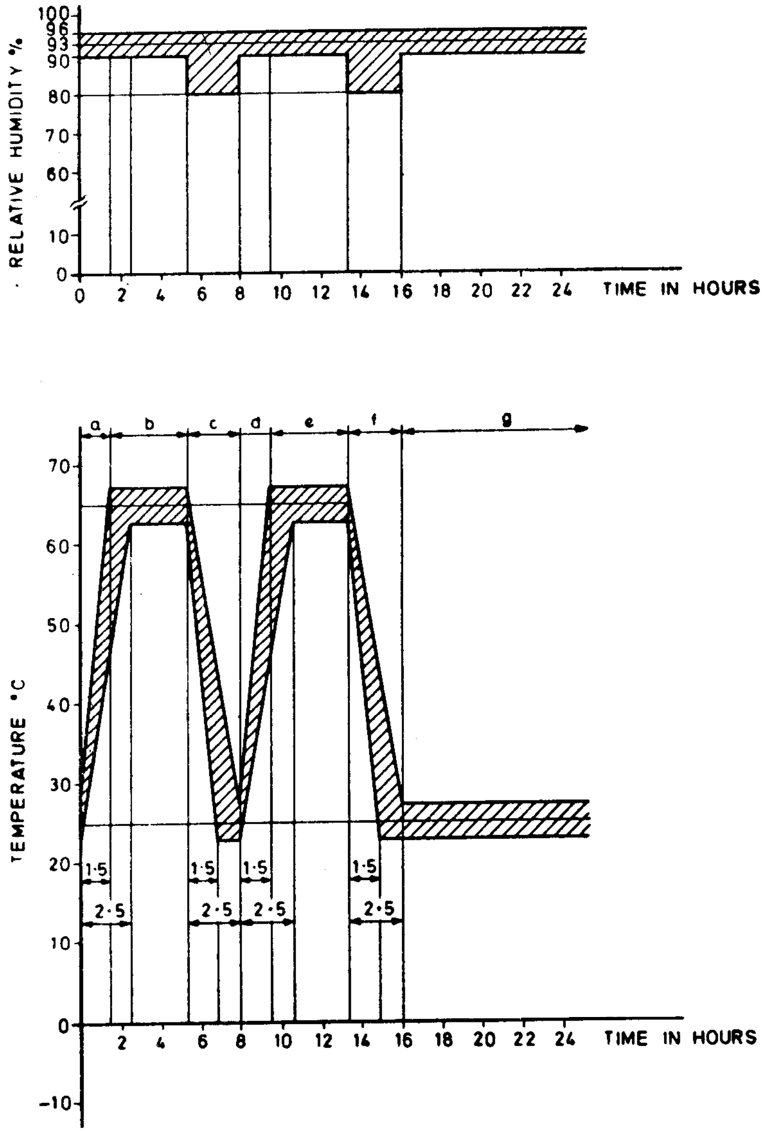
FIG. 1 PRE-CONDITIONING



*Tolerance on time at these points ±5 min.

2A Exposure to Humidity Followed by Exposure to Cold

FIG. 2 CONDITIONING — *Contd*



2B Exposure to Humidity not Followed by Exposure to Cold

Fig. 2 Conditioning

e) Beginning 8 h after the start of the cycle, the temperature shall again be continuously raised to 65 ± 2°C in a period of between 1·5 h and 2·5 h.

During this period, the relative humidity shall be 93 ± 3 percent.

f) The temperature and relative humidity in the chamber shall be maintained at 65 ± 2°C and 93 ± 3 percent respectively until 13·5 h after the start of the cycle.

g) The temperature shall then be allowed to fall to 25 ± 2°C in a period of between 1·5 h and 2·5 h.

During this period, the relative humidity in the chamber shall remain within the limits 80 to 96 percent.

h) The chamber shall then continue to run at a stabilized temperature of 25 ± 2°C and relative humidity of 93 ± 3 percent until the start of the cold sub-cycle or until the end of the 24 h cycle as appropriate.

7.3.1.2 *Description of cold sub-cycle* — Applicable to any five of the first nine cycles (*see* Fig. 2A):

a) Following the completion of the temperature/humidity sub-cycle (*a-f* in Fig. 2A), the chamber is maintained at a temperature of 25 ± 2°C and relative humidity of 93 ± 3 percent for a period of 1·5 h.

b) The item shall then be exposed to cold by lowering the temperature of the chamber or transferring to a second chamber.

If the item is transferred from one chamber to another, the transfer should be completed within a period of 5 min. Beginning 17·5 h after the start of the cycle, the ambient temperature of the chamber shall be reduced to —10 ± 2°C. This temperature shall be reached 18 h after the start of the cycle.

c) Beginning 18 h after the start of the cycle, the temperature shall be maintained at — 10 ± 2°C for a period of 3 h.

No requirement for humidity is specified during the entire cold sub-cycle.

d) Beginning 21 h after the start of the cycle, the temperature shall be raised to 25 ± 2°C. This temperature shall be reached 22·5 h after the start of the cycle (*see* Fig. 2A).

If the item is transferred from one chamber to another, the transfer shall be completed within a period of 10 min to 15 min.

e) When vibration conditioning is included as a part of cold sub-cycle, the item shall be subjected to vibration conditioning specified in **7.3.1.3.** Otherwise, the temperature of the chamber shall be maintained at 25 ± 2°C until the 24 h cycle is completed. During this period, the relative humidity shall be 93 ± 3 percent.

7.3.1.3 *Description of vibration sub-cycle* — Within 15 minutes after completion of **7.3.1.2**, the item shall be subjected to vibration in the frequency 10 to 55 Hz for 15 minutes at standard atmospheric conditions for test, using simple harmonic motion having an amplitude of 0·75 mm (1·5 mm total excursion). The entire frequency range 10 to 55 Hz shall be covered in approximately one minute. The item shall then be maintained at 25 ± 2°C and relative humidity 93 ± 3 percent for remaining period of 24 h cycle.

7.3.1.4 *Description of 24 h cycles with no exposure to cold* — This is applicable to the remaining four of the first nine cycles (*see* Fig. 2B).

Cycles which do not include a cold sub-cycle following the humidity/temperature sub-cycle are the same as described in **7.3.1.1**, except that in **7.3.1.1** (h) the chamber shall be maintained at a temperature of 25 ± 2°C and relative humidity of 93 ± 3 percent until the 24 h cycle is completed.

7.3.1.5 *Description of final cycle* — In the final cycle, following the completion of the temperature and humidity sub-cycle, the chamber is maintained at a temperature of 25 ±2°C and relative humidity of 93 ±3 percent for a period of 3·5 h after which the final measurements are made.

7.3.2 If required by the relevant specification, the item shall be subjected to a polarizing voltage or electrical loading as specified in the relevant specification during temperature/humidity sub-cycles (*see* **7.3.1.1**).

7.4 Final Measurements — Electrical and mechanical measurements may be made under any of the following conditions as required by the relevant specification:

a) At high humidity,

b) Immediately upon removal from the chamber, or

c) After a drying period.

NOTE — It should be realized that many measurements taken under high humidity conditions are not directly comparable with those taken initially or after removal from the chamber.

7.4.1 *At High Humidity* — The measurements shall be made during the last two hours of the 3·5 h period referred to in **7.3.1.4.**

7.4.1.1 The relevant specification shall specify the particular precautions to be followed in making measurements under conditions of high relative humidity, including the means to be adopted for the removal of surface water if this is necessary.

7.4.1.2 The item shall be removed from the chamber after all measurements have been completed.

7.4.2 *Immediately upon Removal from the Chamber* — On completion of the final cycle, the item shall be removed from the chamber and be kept at standard atmospheric conditions for testing.

7.4.2.1 If the initial measurements were made under conditions different from standard atmospheric conditions for testing, the same conditions shall be used for both sets of measurements.

7.4.2.2 Electrical and mechanical measurements as specified shall be made within a period of between 1 h and 2 h after removal from the chamber.

NOTE — Measurements taken early in this time period may be repeated once only, later in the time period. The later reading will be used for failure determination.

7.4.3 *After Drying Period* — On completion of the final cycle, the item shall be removed from the chamber and shall be kept under standard atmospheric conditions for testing for a period of 24 h before the specified final measurements are made.

7.4.3.1 If the initial measurements were made under conditions other than standard atmospheric conditions for testing, the same conditions shall be used for both sets of measurements.

7.4.3.2 Measurements may be made during the 24 h period, but only measurements made at the end of the 24 h period shall be used for failure determination.

8. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

8.1 When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

a) Pre-conditioning procedure, if other than conditions specified in **7.1**;

b) Conditions for initial measurements, if other than standard atmospheric conditions for testing;

c) Initial measurements;

d) State of item during conditioning (for example, electrical or mechanical loading or polarizing voltage) (*see* **7.3.2**);

e) Number of cycles, if other than 10;

f) Vibration conditioning, if required as a part of sub-cycle; and

g) Final measurements.

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